CLAIMS

1. A control apparatus of a robot comprising:

a plurality of shafts interfering with each other;

each of the shafts including a motor, an arm coupled to the motor via a spring element such as a speed reducer and a motor position detector for detecting a position of the motor;

a position control unit and a speed control unit in order to operate each of the shafts in correspondence with an instruction for each of the plural shafts;

an interference force calculating unit for calculating interference force which is exerted to another shaft from an instruction of the own shaft;

a non-interference torque signal forming unit for forming a motor torque instruction signal by which the own shaft is operated in correspondence with the instruction also in such a case that interference force exerted from another shaft is present based upon the calculation value of the interference force exerted from another shaft, and the instruction of the own shaft; and

a non-interference position signal producing unit for producing a motor position signal by which the own shaft is operated in correspondence with the instruction also in such a case that interference force executed from another shaft is present based upon the calculation value of the interference force exerted from another shaft, and the instruction of the own shaft.

2. The robot control apparatus as claimed in claim 1, wherein with respect to interference in the case that the shafts are two shafts,

interference force in the interference force calculating unit is calculated based upon the below-mentioned formulae:

$$d_{is1} = B * x_{ref1} * s^2$$

$$d_{is2} = A * x_{ref2} * s^2$$

a non-interference torque signal in the non-interference torque signal producing unit is calculated based upon the below-mentioned formulae:

$$t_{ref\_ff1} = (J_{m1} * J_{L1} / K1 * s^4 + (J_{m1} + J_{L1}) s^2) * x_{ref1} - (J_{m1} / K1 * s^2 + 1) * d_{is2}$$

$$t_{ref\_ff2} = (J_{m2} * J_{L2} / K2 * s^4 + (J_{m2} + J_{L2}) s^2) * x_{ref2} - (J_{m2} / K2 * s^2 + 1) * d_{is1};$$ and

the non-interference position signal in the non-interference position signal producing unit is calculated based upon the below-mentioned formulae:

$$x_{ref\_ff1} = (J_{L1} / K1 * s^2 + 1) * x_{ref1} - 1 / K1 * d_{is2}$$

$$x_{ref\_ff2} = (J_{L2} / K2 * s^2 + 1) * x_{ref2} - 1 / K2 * d_{is1};$$

in the above-explained formulae, the respective symbols are defined as follows:

J_{m1} : first shaft motor inertia moment

J_{L1} : first shaft arm inertia moment

K1 : spring constant of first shaft speed reducer

J_{m2} : second shaft motor inertia moment

J_{L2} : second shaft arm inertia moment

K2 : spring constant of second shaft speed reducer

A(=B) : coefficients calculated based upon, structures of two shafts, angle between two shafts, and geometrical relationship between two shafts

s : Laplace operator

d_{is1} : interference force exerted from first shaft to second shaft

d_{is2} : interference force exerted from second shaft to first shaft

x_{ref1} : first shaft position instruction

x_{ref2} : second shaft position instruction.

3. The robot control apparatus as claimed in claim 1, wherein in the case that the shafts exceed two shafts, the calculation value of the interference force exerted from another shaft, which is used in the process operations by the non-interference torque signal producing unit and the non-interference position signal producing unit, is equal to a summation of interference force calculation values which are exerted from the respective shafts to the own shaft.